REMARKS

Reconsideration of this application, as amended, is respectfully requested.

Claims 16-35 are pending. Claims 16-35 stand rejected.

Claims 19 and 24 have been amended. Claims 16 – 18, 23, 25, 26, and 28 – 35 have been cancelled. Claims 36 – 41 have been added. Support for the amendments is found in the specification, the drawings, and in the claims as originally filed. Applicants submit that the amendments do not add new matter.

Drawing Objections

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: vent hole 100, see page 7, line 13.

In response applicants have amended the specification to provide accurate reference to Figures 1 – 9.

Specification Objections

The disclosure is objected to because of the following informalities:

Page 1, line 14: change "AL or copper CU" to –Al or copper Cu--;

Page 15, line 8: change "die. Corner and" to die, corner and--.

Applicants have amended the specification to correct these informalities.

Rejections Under 35 U.S.C. § 102(e)

Claims 16, 18-20 and 27 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,114,761 , of Mertol, et al. ("Mertol"). The Examiner stated that

> Mertol, et al. disclose a process of fabricating a microelectronic package where a heat spreader (50) is coupled, using a heat conductive adhesive, to the backside of a die (18), wherein the heat spreader (50) including a plurality of pillars (58) that shift thermally

induced stress away form the corners and edges of the die (18) (fig. 4; col. 6, lines 20-59).

(p. 3, Office Action 1/20/04)

Applicants respectfully submit that claim 19 is not anticipated by Mertol under 35 U.S.C. 102§(e). Amended claim 19 includes the following limitations:

> A process of fabricating a microelectronic package, comprising:
> providing a die affixed to a carrier substrate, the substrate having formed therein a through-hole extending from a first exterior surface to a second exterior surface of the substrate, the through-hole configured to allow the flow of an underfill encapsulation material into a gap between the die, the substrate, and the heat spreader;
> coupling a heat spreader to the backside of the die using heat conductive adhesive, the heat spreader including a plurality of pillars surrounding the die to shift thermally induced stress away from the corners and edges of the die to the pillars of the heat spreader; and
> dispensing of an underfill encapsulation material through the through-hole such that the underfill encapsulation material flows into a gap between the die, the heat spreader, and the substrate.

(Amended claim 19) (emphasis added)

The Examiner has stated that Mertol does not disclose a through-hole from one exterior surface of the substrate to another exterior surface. For this reason, applicants respectfully submit that claim 19 is not anticipated by Mertol. Given that claim 20 – 22, 24 and 27 depend from claim 19, applicants respectfully submit that claims 20 – 22, 24 and 27 are, likewise, not anticipated by Mertol.

Rejections Under 35 U.S.C. § 103(a)

Claims 17, 21 and 22 stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,114,761 of Mertol, et al. ("Mertol") in view of U.S. Patent No. 6,281,573 of Atwood, et al. ("Atwood").

Applicants respectfully submit, however, that claim 19, as amended is not obvious under 35 U.S.C. § 103 in view of Mertol and Atwood. Applicants respectfully submit that the combination of Mertol and Atwood does not disclose the limitation of "dispensing of an underfill encapsulation material through the through-hole such that the underfill encapsulation material

flows into a gap between the die, the heat spreader, and the substrate." Therefore, for the reasons discussed above, applicants respectfully submit that claims 19 – 22, 24, and 27 are not rendered obvious by Mertol in view of Atwood.

Claims 23-26, 28, 29 and 31-35 stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,114,761 of Mertol, et al. ("Mertol") in view of U.S. Patent No. 6,157,086 of Weber ("Weber"). The Examiner has stated that

> Mertol, et al. disclose a process of fabricating a microelectronic package where a heat spreader (50) is coupled, using a heat conductive adhesive, to the backside of a die (18), wherein the heat spreader (50) including a plurality of pillars (58) that shift thermally induced stress away form the corners and edges of the die (18) (fig. 4; col. 6, lines 20-59)...
>
> Weber discloses a process of fabricating a microelectronic package where a through-hole (26) extending from one exterior surface of a substrate (14) to another exterior surface of the substrate (14), wherein the through-hole (26) is configured to allow for passage of underfill material to flow around solder bumps (20) of a chip (12) which are used connect the chip (12) to the substrate (14) (col. 4, lines 3-50)...

(p. 5-6, Office Action 1/20/04) (Emphasis added)

Weber discloses

> An integrated circuit chip package according to one aspect of the present invention includes an integrated circuit chip having an active surface with interconnection pads disposed thereon, and a substrate having a first surface with bonding pads substantially corresponding to the interconnection pads of the integrated circuit chip and a second side having a plurality of solder pads electrically interconnected with the bonding pads. A vent hole extends from the first side to the second side of the substrate, and is positioned beneath the integrated circuit chip when the chip is mounted on the substrate. A plurality of solder bumps electrically connect the interconnection pads of the integrated circuit chip with the bonding pads on the first side of the substrate. A molded underfill material is molded around the integrated circuit chip. The molded underfill material surrounds the solder bumps between the integrated circuit chip and the substrate and extends into the vent hole in the substrate.
>
> A further aspect of the present invention relates to a method of underfilling an integrated circuit chip which has been electrically interconnected to a substrate. The method includes the steps of placing the integrated circuit chip and substrate within a mold cavity, injecting a mold compound into the mold cavity, underfilling a space between the integrated circuit chip and the substrate with the mold compound by the pressure of injection of the mold compound into the mold cavity, and allowing air to escape from between the integrated circuit chip and the substrate during underfilling through a vent in

the substrate.

The present invention addresses the deficiencies of known underfilling methods by underfilling faster and more reliably than the known methods. In addition, the present invention forms an encapsulated integrated circuit chip package and performs underfilling in the same step.

(Col. 2, lines 19-53) (Emphasis added)

According to the present invention, the underfilling material or mold material 16 is provided between the integrated circuit chip 12 and the substrate 14 and surrounding each of the solder bumps 20. The underfill material 16 is a thermoset mold compound which is forced into air gaps between the chip and the substrate by the pressure of the mold compound being forced into the mold tool. The forcing of the mold compound 16 under the chip 12 to provide underfilling provides substantial time savings over the conventional method of allowing the underfill material to be drawn under the chip by capillary action.

The vent hole 26 extending through the substrate 14 allows air to escape from between the integrated circuit chip 12 and the substrate 16 as the mold compound is forced underneath the chip and prevents air pockets from becoming trapped by the mold compound. The vent hole 26 is preferably positioned near a center point of a chip receiving area on the substrate upper surface 22. However, the locations of the solder bumps 20 may require that the vent hole 26 be located somewhat displaced from the center of the chip receiving area on the substrate. Alternatively, multiple vent holes may be used. The vent hole 26 in the substrate 14 has a cross-sectional area which may vary depending on its location and the chip size and is preferably between 0.006 inches (0.152 mm) and 0.020 inches (0.50 mm).

With reference to FIGS. 6-8, the method of underfilling according to the present invention employs a mold 30 having a top half 32 and bottom half 34. The bottom half 34 of the mold is provided with cavities 36 for receiving the substrate solder bumps 24 on the lower side of the substrate. Alternatively, the mold cavities 36 may be eliminated and the substrate solder bumps 24 or pins may be attached after underfilling.

The bottom half 34 of the mold also includes a mold material overflow channel 38 which is positioned to receive mold material which passes through the central vent hole 26 in the substrate. Mold material which collects in the overflow channel 38 forms an overflow bead 48 of mold material on an underside of the substrate 14 as shown in FIGS. 4, 7, and 8.

The top half 32 of the mold defines an upper half of a mold cavity 40 and an upper half of an overflow cavity 42. Between the top and bottom halves of the mold 30, a mold compound inlet 44 is provided through which the mold material is introduced into the mold cavity 40. In addition, a vent 46 connects the mold cavity 40 to the overflow cavity 42.

(Col. 4, lines 3-50) (Emphasis added)

Applicants respectfully submit, however, that claim 19, as amended, is not obvious under 35 U.S.C. § 103 in view of Mertol and Weber. Applicants respectfully submit that the "vent hole" of Weber does not teach or suggest a "through hole" of the claimed present invention. That is, a thorough reading of Weber shows that the "vent hole" is implemented to allow air to escape as the mold compound is forced beneath the chip, thus preventing air pockets. Excess mold material may be forced out of the mold cavity through the vent hole into an overflow chamber, but the injection of mold material into the mold cavity takes place through an inlet formed between the top half of the mold and the bottom half of the mold. (See Weber, col. 4, lns. 14-58, and Figure 7, reference 44).

Neither Weber nor Mertol, or the combination, teach "dispensing of an underfill encapsulation material through the through-hole such that the underfill encapsulation material flows into a gap between the die, the heat spreader, and the substrate". Therefore, applicants respectfully submit that amended claim 19 is not rendered obvious by Mertol in view of Weber. For the reasons discussed above, applicants respectfully submit that claims 20 – 22, 24, and 27 are, likewise, not rendered obvious by Mertol in view of Weber.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 5/19/04 By: _____

Tom Van Zandt
Reg. No. 43,219

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025
(408) 720-8598